

Please answer the questions on a separate sheet and return the exam when you are done.

Name: _____

1. Explain the difference between:

- (a) (1 point) `if (true) {}` and `while(true) {}`
- (b) (1 point) `float a = 3/4` and `float a = 3.0/4.0`
- (c) (1 point) `new MyClass(5)` and `new MyClass[5]`

2. (2 points) What does the following code print on the screen? Provide a full explanation.

```
void setup() {  
    int x = 4;  
    multiplyByTwo(x);  
    println(x);  
}  
  
int x = 3;  
  
void multiplyByTwo(int x) {  
    x = x * 2;  
}
```

3. Insertion sort is an algorithm to sort an array. In this case we call an array sorted if the numbers descend. Insertion sort works like this: for each element in the array, you check how far you can move it to the left without encountering a value that is larger. Next, you make room for the number by moving all the smaller values to the right, and you place the number in its new position.

- (a) (1 point) Below you see an example implementation for insertion sort. Fill in the blanks on your answer sheet.

```
void InsertionSort(int[] num)  
{  
    int key;  
    int i;  
  
    for (int j = 1; j < num.length; j++) {  
        key = num[j];  
        for(i = j - 1; i >= 0 && num[i] < key; i--) {  
            num[_____] = num[_____];  
        }  
        num[i + 1] = key;  
    }  
}
```

- (b) (1 point) Why can `j` start at 1 instead of 0?
- (c) (1 point) Why does `i` have to be defined outside of the second for-loop?
- (d) (1 point) Why do you have to store `num[j]` in `key`? Why not just use `num[j]` instead?

4. A biologist has come up with a new model that predicts how many birds will migrate through The Netherlands in the winter. Her model is based on migration patterns of previous years. Her prediction is that the number of birds in the current year is 1.1 times the number of birds last year plus 0.1 times the number of birds two years ago. This model is valid from 2012 and onward. In 2010, there were 25 million migrating birds and in 2011 there were 26 million birds.
- (a) (3 points) Write a recursive implementation to find the number of birds for any year $y \geq 2010$.
- (b) (1 point) Write out how the recursion is done for $N = 2014$.
5. (a) (2 points) Give the conditions for booleans a , b , and c for when the following expression returns `true`:
- `(a || ((b != a) && c))`
- (b) (2 points) Simplify (rewrite the expression using fewer operators) the following expression, where a, b, c are integers:
- `(a < b || (a >= b && (b < c || b > c)))`
6. (2 points) Write a function called `sum` that calculates the sum of all the integers in a range. For example: `sum(2,3) = 2 + 3 = 5`, and `sum(1,4) = 1 + 2 + 3 + 4 = 10`.
7. (5 points) Write a piece of code that counts how often each digit appears in a global array called `a`. It should print the result to the screen. For example, when given the following array:

```
int a[] = new int[]{1,2,3,8,4,3,6,7,6,9};
```

your code should print:

```
Digit count:
0 : 0
1 : 1
2 : 1
3 : 2
4 : 1
5 : 0
6 : 2
7 : 1
8 : 1
9 : 1
```